SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

SCAG 2012 RTP/SCS Travel Demand Model

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Model Task Force Meeting -- March 28, 2012

Presentation Outline

SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

- Overview of Model Development Program for Year 2008
- 2008 Model Validation
- Model Description and Summary Report

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2012 RTP/SCS Travel Demand Model

Overview of 2008 Model Development Program

Objectives

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The purpose of year 2008 model enhancement program is to develop a base year model for the analysis of 2012 RTP/SCS/PEIR and related programs, including conformity analysis (Title 40 CFR Part 93.122).

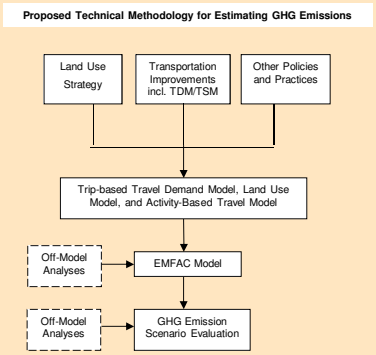
The fundamental objective of this program is to ensure the model be:

- validated against observed data (CFR 93.1 22(b)(1)(i))
- sensitive to changes in the time(s), cost(s), and other factors affecting travel choices (CFR 93.122(b)(1)(vi))
- able to measure the benefits of land use strategies aimed at reducing GHG emissions

Modeling SCS Scenarios

- SB 375 requires a Regional Transportation Plan to include a Sustainable Communities Strategy that demonstrates how the region will meet its greenhouse gas reduction target through integrated land use, housing and transportation planning.

- SCAG SCS scenarios comprise seven elements of strategies:
  - Land Use and Growth
  - Highways and Arterials
  - Transit
  - Travel Demand Management
  - Non-Motorized Transportation System
  - Transportation System Management
  - Pricing



MTF Presentation and Discussion

- **Modeling Programs and Process:**
  - 2008 Model Validation Overview
  - 2012 RTP/SCS Model Development Process and 2008 Model Validation Process
  - Expert Panel Process
  - Model Peer Review Description and Findings
  - SB-375 and RTAC Process
  - Transportation Commission RTP Modeling Guidelines
- **Modeling Projects and Model Input (to list a few):**
  - SCAG Growth Forecast, SED Development and the 2010 Census
  - Mode Choice Model Enhancement Project
  - Goods Movement and Pricing Studies
  - Land Use Model Development
  - Activity Based Model
  - Caltrans' Statewide Model
  - 2010 California Travel Survey
  - Sub-Regional Modeling Tool

Expert Panel and Peer Review

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Expert Panel Meetings and Presentation

- Heavy Duty Truck Model - June 8, 2009
- Pricing Model - August 28, 2009
- Activity Based Model - June 29, 2010

Peer Review Panel

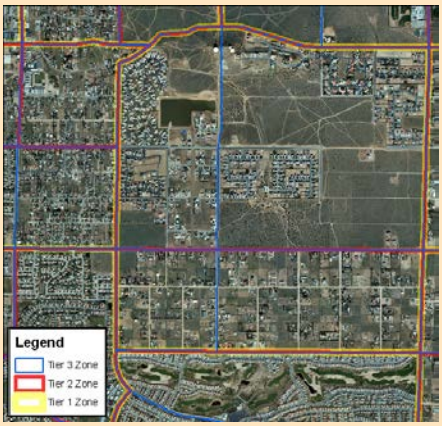
- Pre-meeting (April 26, 2011) and Presentation (May 26, 2011)
- Meeting and Presentation – June 26 & 27, 2011
- Recommendations – June 27, 2011

Products

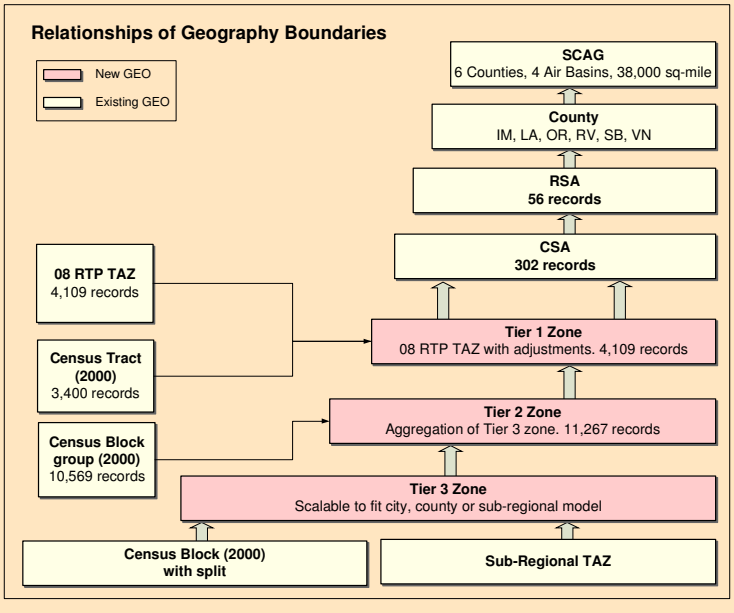
- Development of a Tiered Zone System (July, 2010)
- Regional Highway Network Inventory (Jun, 2009)
- Base Year Highway Network (Sep, 2010)
- Transit LOS Data Collection (June, 2010)
- Base Year Transit Network (Sep, 2010)
- Arterial Speed Study (Feb, 2010)
- Screenline Traffic Count (Mar, 2010)
- Trip-Based Model Update (Dec, 2011)
- Heavy Duty Truck Model (Dec, 2011)
- Congestion Pricing Model Enhancements (Dec, 2011)
- Activity-Based Model (Completed Phase I)
- Land Use Model (Completed Phase I)
- California Household Travel Survey (on-going)
- Peer Review (Jun, 2011)

Tiered Zone System - Process

- To enhance the precision of micro-level land use and smart growth analysis for SCS
- Process
  - Collaboration with local jurisdictions
  - Initial TAZs from cities, counties, and subregions
  - Extensive local review and revisions
  - Tier 1 zones consistent with 08RTP zones (4109 internal zones)
  - Minor Tier 1 boundary adjustment based on local requests



Tiered Zone System - Structure



Tiered Zone System - Summary

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SUMMARY OF TAZ STATISTICS

Modeling Area	2000 Census Tract	2000 Census Block Group	RSA	CSA	08 RTP TAZ (Internal)	Tier 1 Zone (Internal)	Tier 2 Zone (Internal)
Imperial County	29	105	1	15	110	110	239
Los Angeles County	2,052	6,345	21	155	2,243	2,243	5,697
Orange County	577	1,826	10	43	666	666	1,741
Riverside County	343	804	11	38	478	478	1,532
San Bernardino County	244	1,099	7	34	402	402	1,395
Ventura County	155	390	6	17	210	210	663
Total	**3,400**	**10,569**	**56**	**302**	**4,109**	**4,109**	**11,267**

Regional Highway Network Inventory

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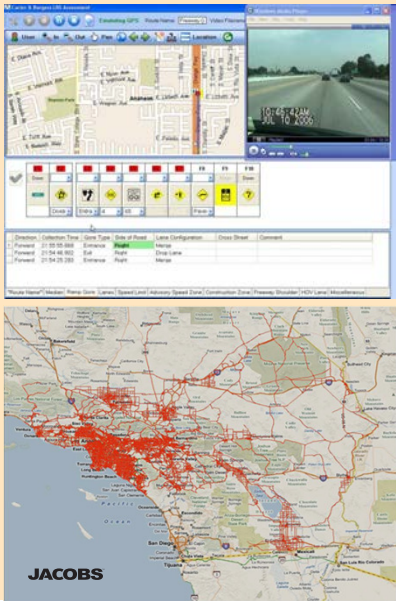
- To gather regional highway network inventory and transfer attributes to SCAG's TransCAD Network
- Network included (over 16,000 centerline miles) all freeways, arterials, urban major collectors
- Primary Attributes:
  - Speed Limits
  - Lanes (by time period)
  - Intersection Control
  - Median Type
  - Directionality (one-way streets)
- Secondary attributes:
  - Shoulder type, parking, school zones, advisory speeds, HOV access, ramp gore points, bike lanes, other controlled intersections



Transit LOS Data Collection

- To prepare transit level of service database for year 2008 model validation
- To build a complete transit database that covers key attributes of NTD and TripMaster for SCAG region
- Received excellent support from transit operators in the region
- Data collected include:
  - Boarding
  - Service (freq., route miles, pass. miles, stops, schedules, fares, VRM, VRH)
  - Operation (cost/revenue, subsidy, vehicles by mode and service type)
  - Performance (accident/road call rates, on-time rate)
  - Contacts
  - Other (on-board surveys, transfers, PNR)
- Consultant:
  MECS

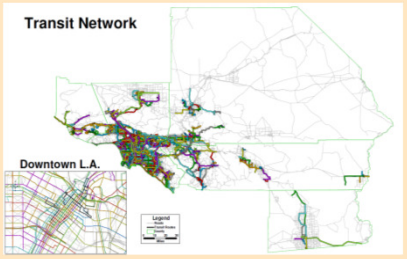
Regional Transit Network Development

- Reviewed and revised methodology for non-transit links
  - Used TeleAtlas to associate census block level data to develop walk access links
- Updated transit network to reflect the following modes of services:
  - Metrolink & Amtrak
  - Urban Rail
  - HSR
  - Transitway Bus
  - Express Bus
  - Rapid Bus
  - Local Bus

- Developed a program to:
  - Automate the process of separating out shortlines/interlines based on unique start-end of bus run
  - Keep the correspondence for pattern/line conversion
  - Calculate more accurate headways and detailed service hours (start time and end time)
  - Developed a TripMaster to TransCAD transit network conversion tool
- Fixed problematic routes and stops not addressed by automation
- Consultants:
  Caliper Corporation
  MECS

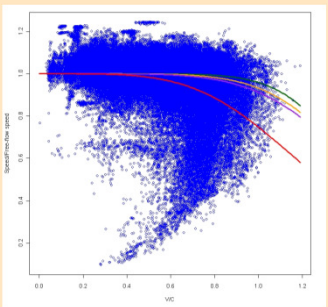
Regional Transit Network - Summary

- Created a year 2008 transit network with over 3,400 routes and 160,000 stops
- Separated shortlines to calculate correct headways
- Added transit routes not covered by TripMaster
- 15 transit networks developed to reflect transit operations by time of day (AM, MD, PM, EV, NT) and day of week (Mon-Fri, Sat, Sun)
- Data collected through Transit LOS project were used to update transit service attributes (headways, base fares, base fare factors, transfer fare factors)



Arterial Speed Study

- Conducted floating car surveys of 31 locations to collect flow and speed data on weekday PM peak periods
- Developed new VDFs for arterials based on data collected
- Researched PeMS database to develop VDFs for freeways
- Updated free flow speed and capacity look-up tables



Screenline Traffic Count

- To establish the validation traffic count dataset
- Obtained and reviewed existing traffic counts taken by member governments and stakeholder agencies
- Developed a regional traffic count database
- Conducted an analysis of count data to apply annual, seasonal, and other factors.
- The final database includes traffic counts by time-of-day, vehicle classification, and in some cases, occupancy for freeways and HOV lanes in SCAG region.
- The final data includes adjusted 2008 average annual April/May/June traffic for all screenline locations by vehicle type and time period.
- Focus was to establish validation counts for roadways that cross screenlines, although counts for non-screenline locations are included as well where data was available and resources provided.
- 34 screenlines with 535 arterial, 182 freeway, and 53 HOV links

Heavy Duty Truck Model

To Support Policy and Project Planning in Areas of:

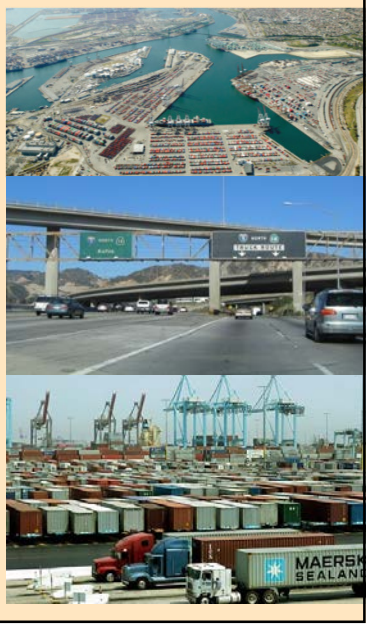
- Port Competitiveness
- Clean Technology Truck Lanes
- Operational Strategies
- Freight Facility Development
- Air Quality/Conformity Analysis
- Economic Impact Analysis

Major Improvements and Data Sources:

- External trip generation/distribution – TRANSEARCH commodity flow
- Internal trip generation – establishment survey, Trimble and ATRI GPS data
- Port/special generator – supply chain survey and port terminal survey

Consultant:

- Cambridge Systematics



Congestion Pricing

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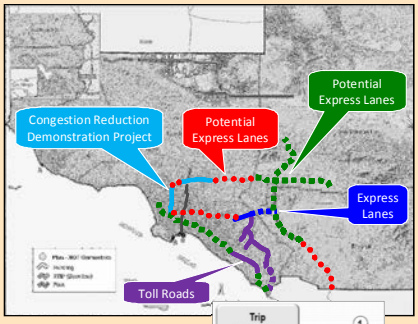
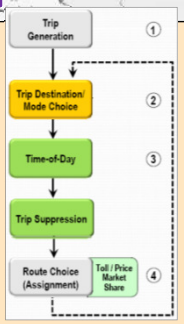
Data:
- Stated Preference Surveys in LA Region – 3,590 completed responses from six SCAG counties
- Analysis of 2005 PSRC "Travel Choices" Data Base – Revealed Preference
- Analysis of 2001 SCAG Household Travel Survey Data
- Analysis of Observed Behavioral Responses (e.g. SR 91 Express Lanes)

Pricing Alternatives Being Evaluated:
- Express Lanes/High Occupancy Toll (HOT Lanes)
- Cordon/Area Pricing (e.g. downtown LA)
- Facility Pricing (e.g., pricing new highway facilities)
- Regional VMT/Emission Fees

Consultants:
- HNTB
- Wilbur Smith and Associates
- Resources Systems Group





Activity-Based Model

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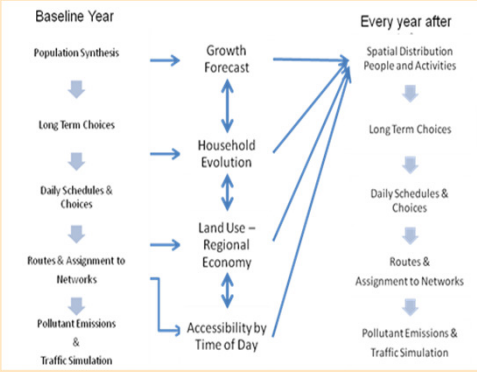
Phase 1 Adapt DFW Model

Phase 2 Develop SCAG Model

Phase 3 Complete ABM w/DTA



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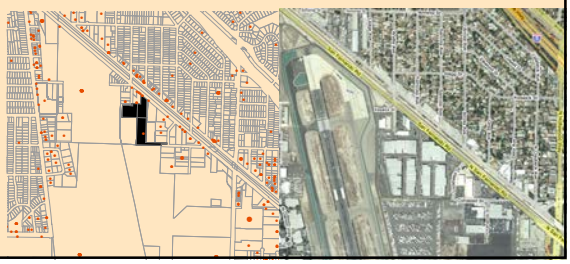
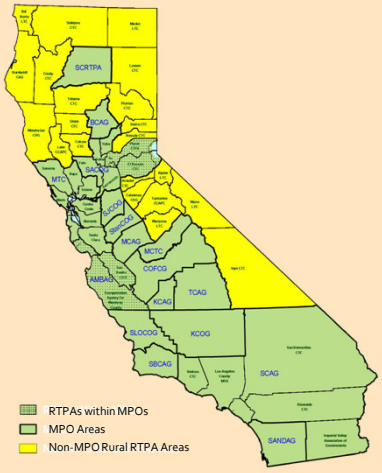
SCAG Land Use Model

- Support demand for comprehensive impact analysis from land use and transportation system scenarios, a tool for land use scenario development
- Collected and processed parcel level data
  - 5.8 million Households by household characteristics
  - 684,000 businesses, 7.8 million Jobs by industry
  - On 4.8 million parcels with land use / floor space characteristics
- PECAS Modeling System
  - Activity Allocation (AA) Model
    - demand for land and price
  - Space Development (SD) Model
    - supply of land
  - Transport Model
    - network skims to AA model
- Consultants:
  - ULTRANS, UC Davis
  - HBA Specto



California Household Travel Survey

- Collaboration between Caltrans & MPOs to address both statewide and regional needs
- Support development of RTP, statewide travel model, next-generation models
- Status:
  - Pre-Survey Design (Goulias) Completed
  - NuStats – Contract Executed, 7/15/2010
  - CHTS Project Kick-off Meeting 9/22/2010
- Funding:
  - Prop 84 - $2,028,000, FY 2009/10
  - Caltrans - $4,302,000, FY 2009/10
  - MPOs - $4,000,000
  - Total - $10,330,000
- Samples: 60,000 Households (5,000 GPS Samples)
- Schedule:
  - 10/10 - 6/11 … Finalize Survey Design
  - 6/11 - 10/11 … Conduct Pre-Test Survey
  - 10/11 - 2/12 … Evaluate/Refine Survey
  - 2/12 - 3/13 … Conduct Main Survey
  - 3/13 - 6/13 … Analysis & Final Report



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2012 RTP/SCS Travel Demand Model

2008 Model Development & Validation

Modeling Approach

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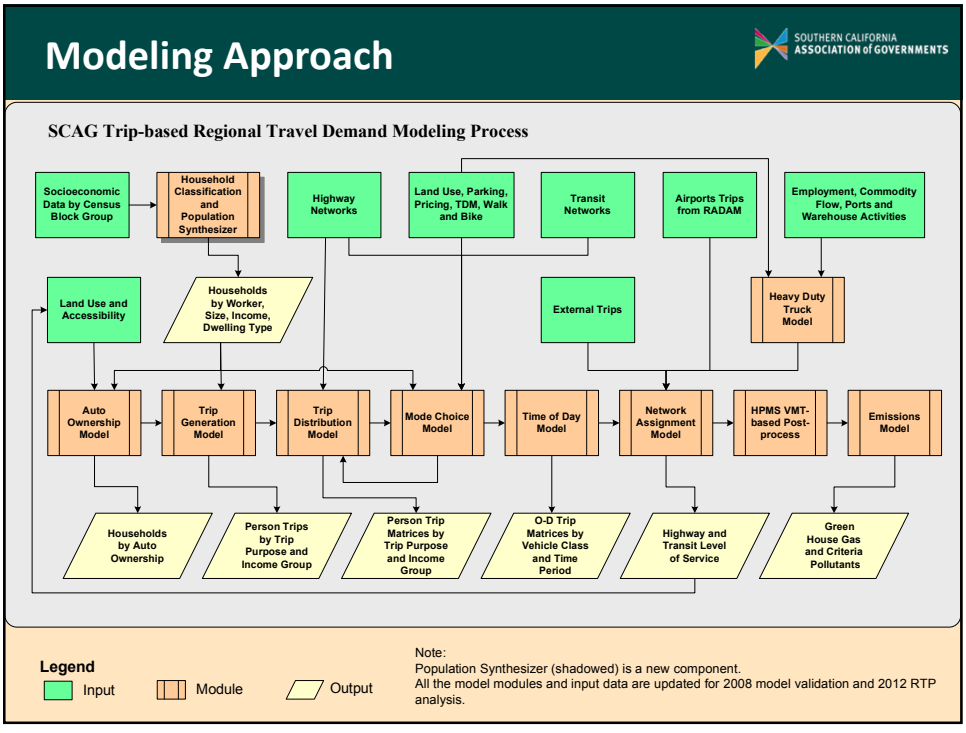

Note:
Population Synthesizer (shadowed) is a new component.
All the model modules and input data are updated for 2008 model validation and 2012 RTP analysis.

Model Development Process

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Tier 1 Develop
- Based on 2001 Household Survey data
- Model estimation – auto availability, trip generation, destination choice
- Model calibration – all above + mode choice

Tier 2 Implement
- Based on preliminary Year 2000 socio-economic data
- Model calibration– auto ownership, destination choice
- Improve run time

Tier 2 Validate
- Based on updated Year 2008 socio-economic data
- Incorporate HDT components
- Refine individual and global model calibration and validation

Tier 2 Refine
- Incorporate Peer Panel Review recommendations

Model Update Objectives

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Improve Sensitivity to Smart Growth	• Implement Tier 2 zone demand model • Incorporate D-Variable effects in demand model • Improve intra-zonal trip forecasting • Perform Smart Growth sensitivity tests
Improve Sensitivity to Road Pricing	• Represent all first-order pricing effects: mode choice, time-of-day choice, route choice • Implement destination choice models linked to mode choice logsums
Improve Transit Forecasting	• Incorporate newly updated highway geography and transit networks • Update path-building procedures • Overhaul mode choice model
Improve Traffic Assignment	• Implement additional time periods • Implement toll trip and HOV assignment method • Perform detailed regional traffic validation
Improve High Speed Rail Forecasting	• Add HSR choice to mode choice model • Link to CAHSRA inter-regional trip tables
Improve Representation of Travel Markets	• Use PopSyn in lieu of household allocation models • Review and update model assumptions and trip market segmentation

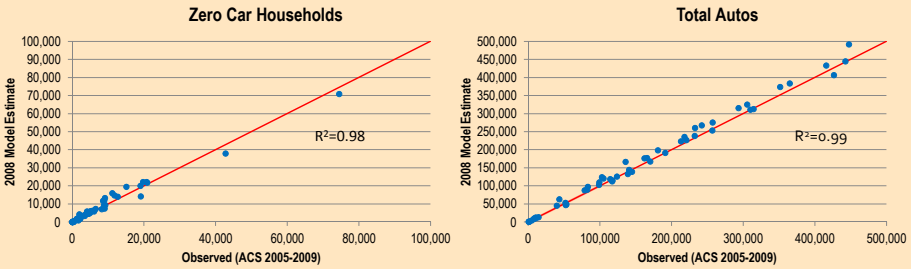
Data Sources

- 2001 SCAG Post-Census Travel Survey
  - 16,000 households region-wide
- 1999 Census Transportation Planning Package
- 2005-2009 & 2006-2008 American Community Survey releases
- 2008 National Household Travel Survey
- On-Board Surveys (2001, 2006, 2008, 2010)
- 2008 Transit Boardings
- 2008 Traffic Counts & Speeds
- 2008 HPMS Estimates

Auto Ownership Validation

ACS 2005-2009 Auto Availability						
Residence County	**0Cars**	**1Car**	**2Cars**	**3Cars**	**4+Cars**	**Total**
Imperial	5,022	14,658	16,371	6,919	3,435	**46,405**
Los Angeles	300,094	1,105,169	1,123,597	430,792	216,026	**3,175,678**
Orange	45,379	279,591	407,333	159,368	81,130	**972,802**
Riverside	29,360	191,759	254,724	112,203	57,038	**645,084**
San Bernardino	30,030	162,589	224,543	112,044	59,681	**588,887**
Ventura	10,497	67,105	103,869	49,793	25,876	**257,140**
Total	**420,382**	**1,820,871**	**2,130,438**	**871,119**	**443,186**	**5,685,995**
Forecast Difference (%), County Normalized						
Residence County	**0Cars**	**1Car**	**2Cars**	**3Cars**	**4+Cars**	**Total**
Imperial	2.67%	6.86%	-7.01%	-1.65%	-0.87%	2.67%
Los Angeles	-0.64%	-0.18%	-0.61%	0.15%	1.29%	-0.64%
Orange	-0.51%	1.09%	-1.24%	-0.74%	1.40%	-0.51%
Riverside	1.27%	5.38%	-5.61%	-1.83%	0.80%	1.27%
San Bernardino	0.65%	3.40%	-4.30%	-1.53%	1.77%	0.65%
Ventura	0.28%	2.74%	-3.82%	-0.64%	1.45%	0.28%
Total	**-0.20%**	**1.23%**	**-1.87%**	**-0.45%**	**1.29%**	**-0.20%**

Auto Ownership Validation



Regional Statistical Area Validation

Auto Ownership Validation

Mixed Employment, Household & Intersection Density Validation

Auto Availability	Share of Households by Mixed Density Level							
	ACS 2005-2009				2008 Model Estimate			
	7 or less	7 to 8.5	8.5 to 9.5	9.5 +	7 or less	7 to 8.5	8.5 to 9.5	9.5 +
0	3%	4%	7%	13%	4%	5%	7%	13%
1	24%	27%	32%	43%	29%	29%	33%	41%
2	42%	40%	37%	32%	37%	39%	37%	31%
3	20%	19%	15%	9%	19%	17%	15%	10%
4+	10%	10%	8%	4%	12%	10%	9%	6%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Auto Ownership Validation

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Non-Motorized Accessibility Validation

Auto Availability	Share of Households by Non-Motorized Accessibility							
	ACS 2005-2009				2008 Model Estimate			
	6 or less	6 to 8	8 to 10	10 +	6 or less	6 to 8	8 to 10	10 +
0	4%	8%	13%	25%	4%	7%	13%	22%
1	25%	33%	43%	43%	29%	33%	41%	44%
2	41%	37%	32%	26%	37%	36%	30%	23%
3	20%	15%	9%	4%	18%	14%	10%	7%
4+	10%	8%	4%	2%	11%	9%	6%	4%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Auto Ownership Validation

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Transit Logsum Accessibility Validation

Auto Availability	Share of Households by Transit Logsum Accessibility							
	ACS 2005-2009				2008 Model Estimate			
	9 or less	9.5 to 12	12 to 13.5	13.5 +	9 or less	9.5 to 12	12 to 13.5	13.5 +
0	5%	5%	7%	17%	6%	4%	7%	16%
1	29%	27%	33%	42%	36%	28%	33%	43%
2	40%	40%	38%	29%	32%	40%	38%	25%
3	18%	19%	15%	8%	16%	17%	14%	10%
4+	9%	9%	8%	4%	11%	10%	8%	7%
Total	100%	100%	100%	100%	100%	100%	100%	100%

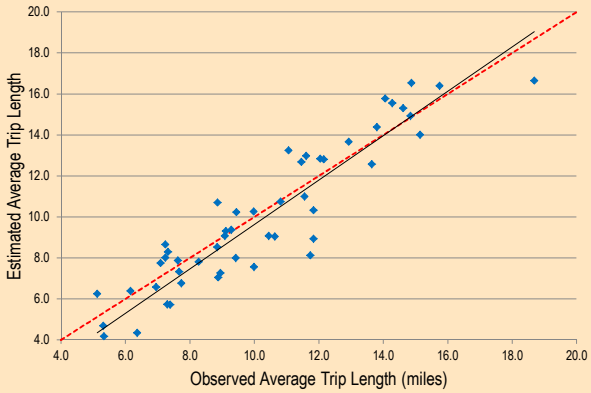
Trip Productions Validation

Trip Purpose	2001 Household Survey	2000 Model Estimate	% Difference		2008 Model Estimate	2008 to 2000 Change
HBWD	7,951,000	8,245,000	4%		8,964,000	1.09
HBWS	2,496,000	2,575,000	3%		2,738,000	1.06
HBSc	4,605,000	4,755,000	3%		4,852,000	1.02
HBU	662,000	667,000	1%		688,000	1.03
HBSh	4,446,000	4,710,000	6%		5,360,000	1.14
HBSR	4,242,000	4,362,000	3%		4,934,000	1.13
HBO	7,598,000	7,965,000	5%		8,939,000	1.12
HBSP	6,595,000	6,720,000	2%		7,618,000	1.13
OBO	11,233,000	12,709,000	13%		14,543,000	1.14
WBO	3,248,000	3,433,000	6%		3,524,000	1.03
Total	**53,078,000**	**56,341,000**	**6%**		**62,160,000**	**1.10**

Trip Productions Validation

Trip Purpose	2008 Model Estimate	2008 NHTS
HBWD	8,964,000	7,908,000
HBO	35,127,000	36,813,000
NHB	18,067,000	15,658,000
Total	**62,064,000**	**60,380,000**

Trip Distribution Validation

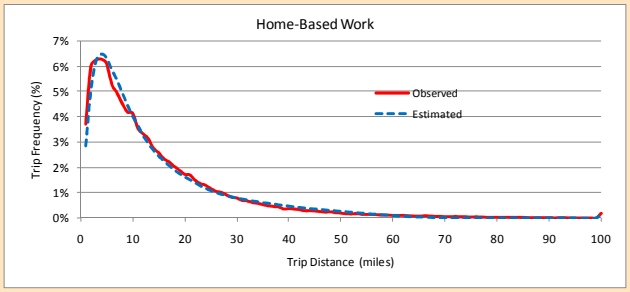


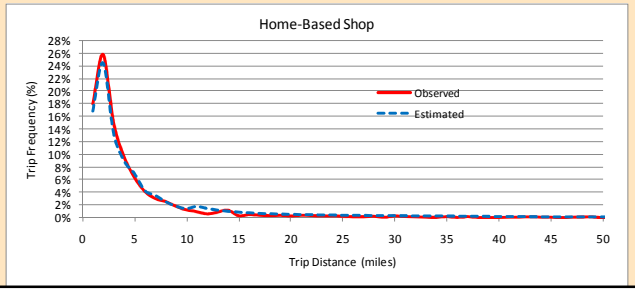
Validation of Average Trip Length to 2001 Household Survey

(points represent purpose/income/time periods)

Trip Distribution Validation

Trip Purpose	Coincidence Ratio
HBW	0.91
HBSH	0.87
HBSR	0.85
HBSP	0.86
HBO	0.89
HBSC	0.89
WBO	0.83
OBO	0.88
All Purposes	**0.92**





Trip Distribution Validation

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Worker Flows (ACS 2005-2009)								
		25	37	59	65	71	111	SCAG
25	Imperial	50,095	110	55	1,180	100	-	51,540
37	Los Angeles	440	4,091,655	187,305	15,960	59,690	37,335	4,392,385
59	Orange	30	176,265	1,206,415	15,390	12,070	600	1,410,770
65	Riverside	540	46,615	67,595	608,895	92,430	450	816,525
71	San Bernardino	150	126,095	36,735	71,540	592,570	745	827,835
111	Ventura	-	66,630	1,255	195	440	292,115	360,635
	SCAG	**51,255**	**4,507,370**	**1,499,360**	**713,160**	**757,300**	**331,245**	**7,859,690**

Forecast Difference (%), Trips vs. Worker Flow, County Normalized								
		25	37	59	65	71	111	SCAG
25	Imperial	0.3%	0.1%	0.1%	-0.5%	0.0%	-	0.0%
37	Los Angeles	0.0%	-4.1%	3.6%	0.1%	0.3%	0.2%	0.0%
59	Orange	0.0%	4.4%	-4.8%	0.0%	0.4%	0.0%	0.0%
65	Riverside	0.0%	0.0%	3.8%	-7.0%	3.2%	0.0%	0.0%
71	San Bernardino	0.0%	0.5%	3.6%	3.1%	-7.2%	0.0%	0.0%
111	Ventura	-	10.8%	0.0%	0.0%	0.0%	-10.6%	0.0%
	SCAG	**0.0%**	**-1.1%**	**2.9%**	**-0.9%**	**-0.7%**	**-0.2%**	**0.0%**

Mode Choice Model Validation

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HBW Peak Estimated Mode Shares							
Household Segment	Drive Alone	Shared Ride 2	Shared Ride 3	Shared Ride 4+	Transit	Non-Motorized	Total
No Cars	5.4%	16.0%	8.8%	5.3%	51.7%	12.7%	100%
Car Competition	40.2%	18.1%	8.2%	4.2%	22.3%	7.1%	100%
Income 0-25K	64.6%	7.6%	3.4%	1.7%	19.6%	3.1%	100%
Income 25-50K	83.5%	6.9%	3.3%	1.5%	2.3%	2.4%	100%
Income over50K	90.9%	3.9%	2.2%	1.0%	0.8%	1.3%	100%
Total	**79.3%**	**6.8%**	**3.4%**	**1.6%**	**6.3%**	**2.6%**	**100%**

HBW Peak Target Mode Shares							
Household Segment	Drive Alone	Shared Ride 2	Shared Ride 3	Shared Ride 4+	Transit	Non-Motorized	Total
No Cars	4.9%	14.8%	8.7%	5.7%	51.4%	14.5%	100%
Car Competition	41.3%	18.3%	8.5%	4.5%	19.5%	7.9%	100%
Income 0-25K	64.1%	7.8%	4.0%	2.4%	18.0%	3.8%	100%
Income 25-50K	82.9%	6.9%	3.5%	1.7%	2.3%	2.7%	100%
Income over50K	91.2%	3.7%	1.8%	0.7%	1.2%	1.3%	100%
Total	**79.2%**	**6.7%**	**3.3%**	**1.6%**	**6.3%**	**2.9%**	**100%**

Mode Choice Model Validation

SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

HBW Off-Peak Estimated Mode Shares							
Household Segment	Drive Alone	Shared Ride 2	Shared Ride 3	Shared Ride 4+	Transit	Non-Motorized	Total
No Cars	6.1%	12.8%	9.4%	6.0%	49.9%	15.9%	100%
Car Competition	43.3%	18.7%	8.6%	4.4%	16.9%	8.1%	100%
Income 0-25K	67.4%	7.7%	3.5%	1.7%	16.0%	3.8%	100%
Income 25-50K	83.3%	6.8%	3.4%	1.6%	1.9%	3.0%	100%
Income over50K	90.2%	3.8%	2.4%	1.0%	0.7%	1.9%	100%
Total	**79.6%**	**6.8%**	**3.6%**	**1.7%**	**5.1%**	**3.3%**	**100%**

HBW Off-Peak Target Mode Shares							
Household Segment	Drive Alone	Shared Ride 2	Shared Ride 3	Shared Ride 4+	Transit	Non-Motorized	Total
No Cars	5.0%	11.6%	9.0%	6.3%	51.5%	16.6%	100%
Car Competition	43.1%	18.8%	9.0%	4.8%	16.3%	8.1%	100%
Income 0-25K	66.2%	8.1%	4.3%	2.6%	14.6%	4.1%	100%
Income 25-50K	82.7%	7.0%	3.7%	1.8%	1.8%	3.0%	100%
Income over50K	91.1%	3.7%	2.0%	0.8%	0.7%	1.8%	100%
Total	**79.5%**	**6.7%**	**3.5%**	**1.7%**	**5.2%**	**3.3%**	**100%**

Highway Assignment Validation

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Volume Group By Facility	Daily Vehicle Volumes LM				Daily Vehicle Volumes HDT				Daily Vehicle Volumes TOTAL		
	Model	Count	Ratio	RMSE	Model	Count	Ratio	RMSE	Model	Count	Ratio
0 - 4,999	493,340	393,897	1.25	146.42	16,732	23,981	0.70	129.10	510,073	417,878	1.22
5,000 - 24,999	3,892,077	3,720,869	1.05	49.83	150,862	261,309	0.58	73.97	4,042,939	3,982,177	1.02
25,000 - 49,999	3,850,230	3,682,133	1.05	35.98	139,577	238,827	0.58	68.57	3,989,807	3,920,960	1.02
50,000 - 99,999	1,225,942	1,444,490	0.85	33.80	159,907	173,275	0.92	44.12	1,385,849	1,617,766	0.86
100,000 - 199,999	2,827,925	2,693,574	1.05	25.86	309,227	262,566	1.18	58.28	3,137,152	2,956,140	1.06
200,000 or More	9,772,715	9,110,737	1.07	26.82	856,742	658,063	1.30	68.89	10,629,456	9,768,800	1.09
Total	**22,062,228**	**21,045,700**	**1.05**	**38.97**	**1,633,047**	**1,618,021**	**1.01**	**85.20**	**23,695,275**	**22,663,721**	**1.05**

Highway Assignment Validation

County		VC SCCAB		SCAB		MDAB		SSAB		Total		County Total
		Auto	Truck	Auto	Truck	Auto	Truck	Auto	Truck	Auto	Truck	
Imperial	Model							3,890	534	3,890	534	4,423
	HPMS							4,660	830	4,660	830	5,490
Los Angeles	Model			197,322	12,778	6,574	373			203,896	13,151	217,048
	HPMS			205,014	11,585	8,472	605			213,486	12,190	225,676
Orange	Model			71,189	3,512					71,189	3,512	74,700
	HPMS			73,933	3,400					73,933	3,400	77,333
Riverside	Model			39,276	2,719	1,324	693	8,006	1,236	48,606	4,648	53,254
	HPMS			40,546	3,436	1,469	621	9,471	1,667	51,486	5,724	57,210
San Bernardino	Model			31,213	2,440	16,380	3,369			47,594	5,809	53,403
	HPMS			35,615	3,307	17,936	3,806			53,550	7,113	60,663
Ventura	Model	15,973	1,405							15,973	1,405	17,378
	HPMS	18,698	953							18,698	953	19,651
Total	**Model**	**15,973**	**1,405**	**339,001**	**21,449**	**24,278**	**4,435**	**11,895**	**1,770**	**391,147**	**29,059**	**420,206**
	HPMS	**18,698**	**953**	**355,108**	**21,728**	**27,877**	**5,032**	**14,131**	**2,497**	**415,814**	**30,210**	**446,024**
	Ratio	**0.854**	**1.474**	**0.955**	**0.987**	**0.871**	**0.881**	**0.842**	**0.709**	**0.941**	**0.962**	**0.942**

Transit Assignment Validation

Transit Mode	2008 Estimated Boardings	2008 Actual Boardings	Ratio
Commuter Rail	44,600	48,400	**0.92**
Urban Rail	249,800	276,100	**0.90**
MTA Bus *	1,315,600	1,554,700	**0.85**
Other Transit **	1,133,100	899,900	**1.26**
Total Boardings	**2,743,100**	**2,779,100**	**0.99**

**** MTA Local, Rapid, Express & BRT***
***** Non-MTA Local & Express Transit Carriers***

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2012 RTP/SCS Travel Demand Model

Model Description & Summary Report

Household Markets

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Model	Income	Size	Workers	Autos	Housing Unit	Age of Head of Hhld.	Age
Auto Ownership	X	X	X		X		
Trip Production							
HBW, WBO	X		X			X	
HBSC, HBCU							X
HBO, OBO	X	X		X			
Trip Distribution & Mode Choice							
HBW, WBO	X		X	X			
HBSC, HBCU	X						
HBO, OBO	X	X		X			

Land Use Form and Accessibility

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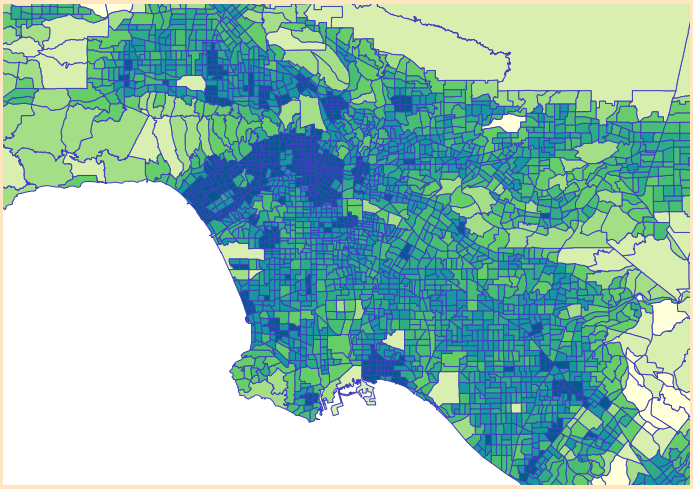
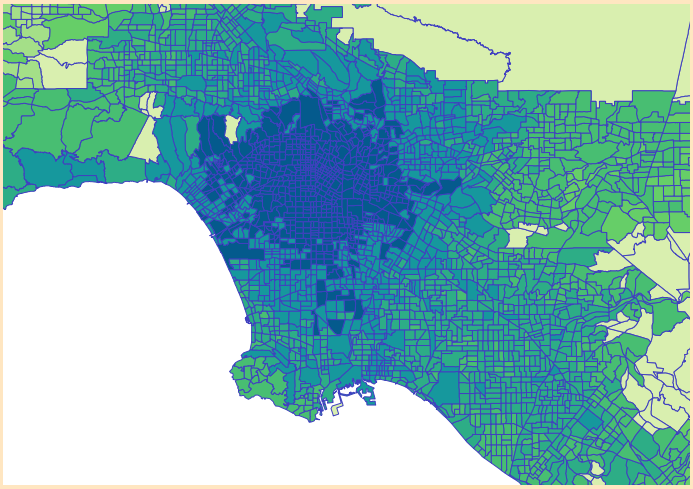
Mixed Residential, Employment and Intersection Density



Land Use Form and Accessibility

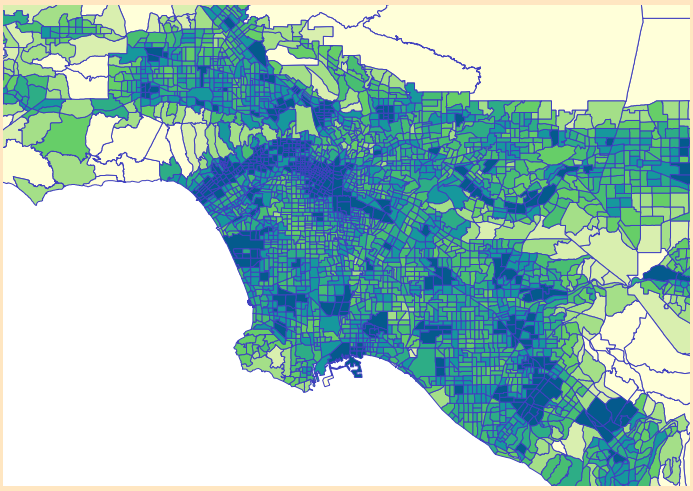
SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

Transit Accessibility to Employment (Logsum)



Land Use Form and Accessibility

Non-Motorized Accessibility to Employment



Auto Availability Model

- Multinomial logit model
- Explanatory variables:
  - Household size – 1, 2, 3, 4 or more persons
  - Household income – <25K, 25-50k, 50-100K, 100K+
  - Number of workers in household – 0, 1, 2, 3 or more workers
  - Type of housing unit (single family detached, other)
  - Transit accessibility to employment
  - Mix household, employment and intersection density
  - Non-motorized accessibility to employment

Trip Generation Model

- Development of detailed joint household distributions using population synthesizer
- Modified HBW cross-classification model
- Household income used as additional cross-classification variable
- Trip productions grouped by household income & car competition segments for downstream models:
  - Zero cars, all income
  - Car competition, all income
  - Car sufficient, low income
  - Car sufficient, medium income
  - Car sufficient, high income

Trip Distribution Model

- Gravity models for HBSC and HBCU
- Destination choice models for all other purposes

$$U_{ijm} = \theta \times LS_{ijm} + \sum_k \beta^k D_{ij}^k + \sum_k \delta_m^k N_m^k D_{ij}^k + \sum \gamma_m^k M_i^k IZ_j + Ln(A_{jm}) + C_j$$

- HBW & HBNW stratified by household income and car sufficiency

Trip Distribution Model

- Model estimation approach
  - Based on the 2001 Post-Census Household Survey, combined with 2000 mode choice logsums, skims and employment data
  - Sampling-by-importance combined with an exploded sample to construct the destination choice set of each trip observation

$$W_j = A_j \times exp(-2D_{ij}/D)$$

$$P_j = \frac{W_j}{\sum_j W_j}$$

  - Size terms pre-calculated based on PUMS data (HBW) or household survey data

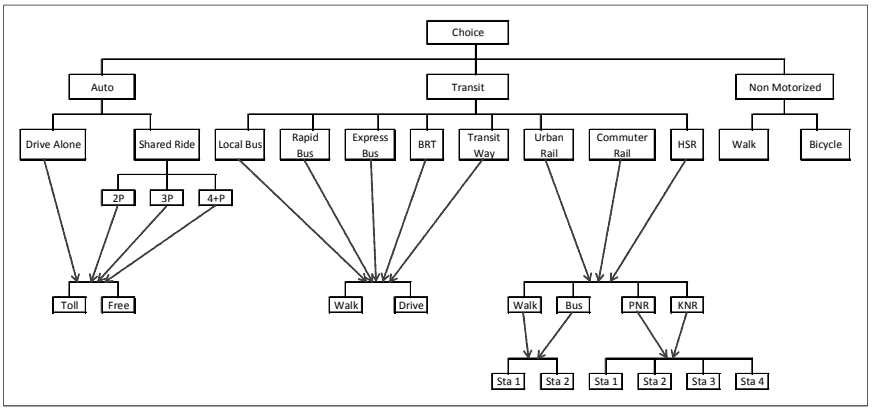
Mode Choice Model

- Highway Choices
  - Over 10,000 lane miles of limited access roadways
  - 700+ lane miles of HOV 2+ roadways
  - 20 lane miles of HOV 3+ roadways
  - 2 dynamically-priced HOT lanes facilities (in operation by 2013)
  - Toll roads

Mode Choice Model

- Transit Options
  - Over 60 different transit carriers
  - Wide variety of transit technologies & operations
  - Characterized by trip purpose, trip distance and type of traveler
    - Short distance local & rapid bus, mostly low income
    - Medium distance urban rail (expanding) and various types of express bus service, including transit-way buses & BRT
    - Long distance commuter rail, mostly high income, competing with express buses on some markets
    - High-speed rail (LAX to ONT, Sacramento to San Diego)

Mode Choice Model



Mode Choice Model

- Rail Station Choice
  - 4 sets of paths created to support station choice
    - Zone to station – bus & walk access allowed, no rail
    - Zone to station – only walk allowed, no rail
    - Station to zone – bus & walk access allowed, no rail
    - Station to station – only rail allowed
  - Best paths determined by the mode choice model by minimizing the entire utility of all station-to-station combinations for a given OD

Mode Choice Model

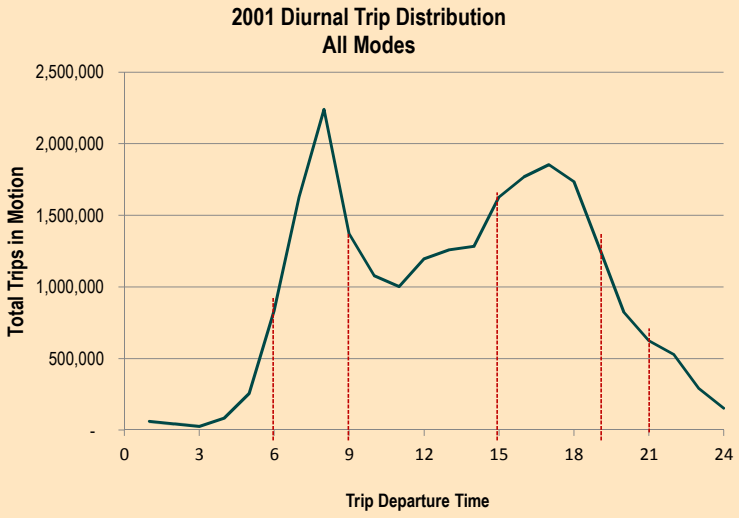
- Bias constant specification
  - Income/Car sufficiency - stratified constants:
    - Auto & non-motorized modes
    - Drive to transit, PNR, KNR
  - Generic constants for all line-haul modes
  - Global transit constant
    - Stratified by income and trip distance
    - Includes a mixed density component, calibrated to reproduce transit shares as a function of density

Heavy Duty Truck Model

- SCAG HDT trip markets:
  - Internal
  - Internal/External & Thru Truck Trips
  - Port Truck Trips
  - Intermodal Terminal Truck Trips

- Model updates:
  - Revised trip rates using more recent survey data
  - Updated IE & EE models with Transearch data
  - Updated Port model assumptions and terminal operating characteristics
  - Calibrated & validated to 2008 conditions consistent with passenger model updates

Time of Day Segmentation



Highway Assignment

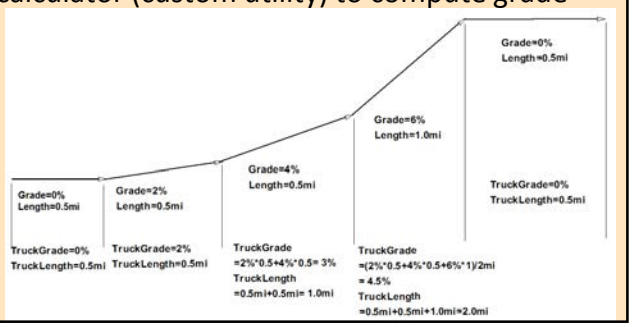
- Static user equilibrium
- Generalized cost (time, op. cost, toll/user fee)
- VOTs stratified by vehicle class and time period
- Vehicle classes:
  - Drive alone
  - Shared Ride 2 No HOV & Shared Ride 2 HOV
  - Shared Ride 3+ No HOV & Shared Ride 3+ HOV
  - Heavy Duty Trucks – Light, Medium, Heavy
- Modified BPR volume-delay functions
- Built-in HOV and Toll Diversion models

Highway Assignment

- Travel time feedback to trip generation
  - Up to 5 feedback loops performed
  - MSA applied to average volumes over loops (1/2 step size)
  - RMSE and other convergence statistics reported for each loop – AM DA travel time, AM DA trips, AM volumes
  - User has the option of additional loops to tighten convergence
  - Congested times calculated using the averaged volumes
  - Peak travel times is combined AM & PM peak time

Highway Assignment

- Passenger Car Equivalents
  - Function of link length, grade and truck volume
  - Grade and truck link length calculation
    - Point elevation data obtained by polling the USGS website
    - Run grade calculator (custom utility) to compute grade & length

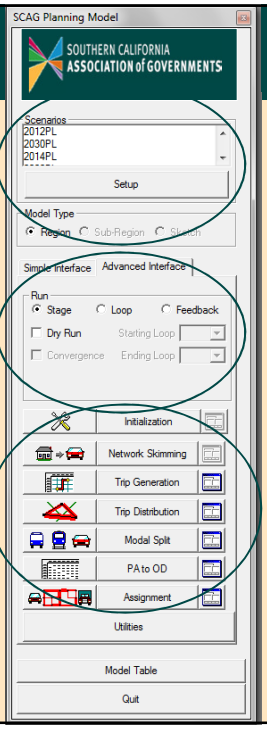


User Interface

Scenario management

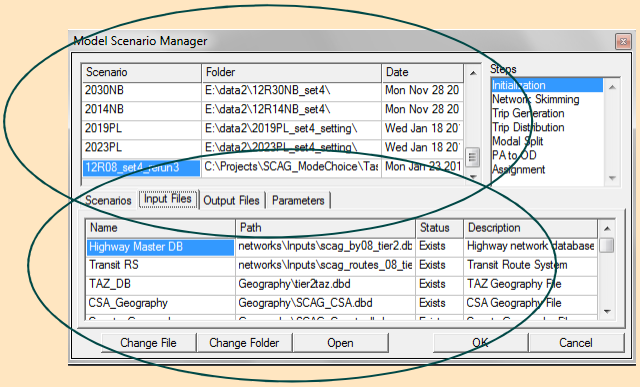
Model run control

Model component execution options



User Interface Scenario Manager

Identifies location of each scenario



Identifies and provides access to input files, output files and parameter values

Runtime & Optimizations

- Runtime:
  - 5 feedback loop run: ~140 hours
  - Hexa-Core Intel Xeon Processor (3.5 GHz, 24 Gb RAM)
- Optimizations:
  - TransCAD 6.0 64-bit program and platform allows many operations to run in memory
  - Multi-threading allows operations to access memory on demand
  - Memory-based matrix operations
  - Re-doing the looping structure of some procedures
  - Combining market segments to reduce I/O and common calculations
  - Avoid un-necessary intermediate calculations
  - Internal matrix squeezing / compressing procedures
  - Bi-conjugate UE highway assignment

Validation Report

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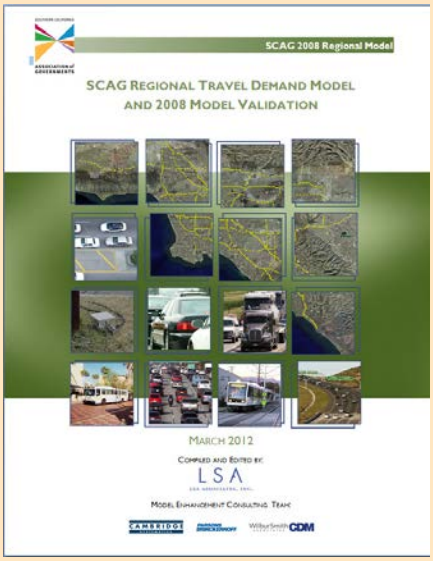
Includes detailed descriptions of model specification, model calibration & validation, and 2008 summary estimates

- Overview
- Socio-Economic Input Data
- Trip Generation
- Transportation Networks
- Trip Distribution
- Mode Choice
- Heavy Duty Truck Model
- Trip Assignment



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Thank you!